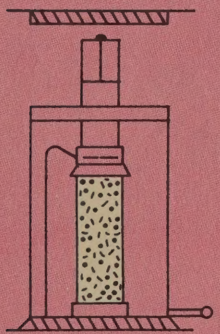
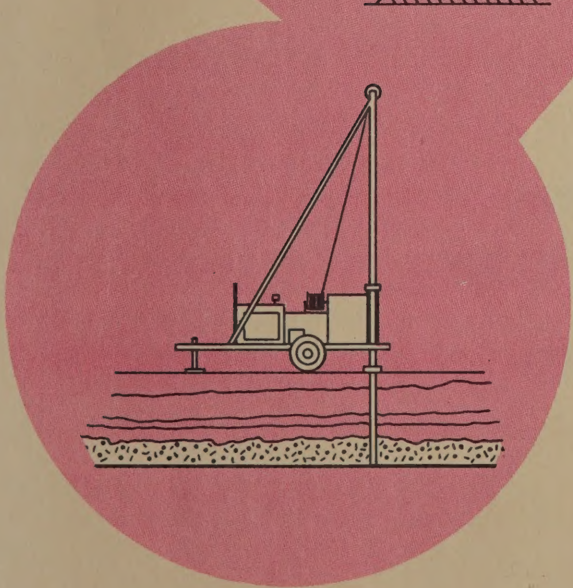
STATE OF NEW YORK
DEPARTMENT OF TRANSPORTATION

SOIL MECHANICS BUREAU

CASE STUDY

FEBRUARY, 1978





SUBJECT

CONTROLLED CRACKING OF SOIL CEMENT BASE COURSE

PROJECT

ANCRAM-COPAKE
COUNTY ROAD 55
FASS 74-1
COLUMBIA COUNTY
PIN 8540.00

SM 238b (1/73)

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ON

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BY

RICHARD S. GRANA
SENIOR SOILS ENGINEER

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I INTRODUCTION

Uncontrolled shrinkage cracking of a soil cement course is a common problem. An attempt was made to control this cracking by utilizing reinforcing bars pressed into its top surface during final compaction and removed prior to placement of the wearing course.

II PROJECT DESCRIPTION

In July of 1974, a contract was let for a project at two locations along County Road 55 in the Columbia County towns of Ancram and Copake.

The contract consisted of both reconstruction and construction on new alignment of approximately 2.10 miles of roadway (Part 1 - 1.37 miles; Part 2 - 0.73 miles). This work was progressed to eliminate substandard curves. Figure 1 indicates the general location of the project.

The design of the project was done by Columbia County with review, award, and inspection performed by the New York State Department of Transportation.

As is the case in many Columbia County designed projects, soil cement was utilized in the typical pavement section (Figure 2). As part of the soil cement specification, a special procedure was specified to attempt to control the inevitable transverse shrinkage cracking which occur in a soil cement course. This report details this special procedure and the results obtained.

III Design

An attempt was made to control the cracking in the soil cement course which eventually reflects through to the riding surface. Normally an erratic cracking pattern occurs both in longitudinal spacing and in transverse alignment. A test section was established between C/L Stations 135+00 and 143+00 on Part 1 of this project. In that section, No. 5 reinforcing bars (5/8 inch diameter) were to be placed transversely 20 feet on centers on the soil cement course, and rolled into the surface. After compaction, these bars were to be removed resulting in a grooved top surface. Hopefully, this would result in "built-in" shrinkage joints and eliminate the erratic pattern. This test area contained both a cut and fill section.

IV CONSTRUCTION

The soil cement course for this project was designed by the Soil Mechanics Bureau to contain 8% of cement by weight. This percentage is equivalent to one half of a bag of cement per square yard for a 6 inch depth or 3 bags of cement per cubic yard of material compacted. Mixing was done by a Barber Green-Twin Shaft Pugmill Mixer, with calibration done by members of this Bureau (See Photo 1). Placement was done by a spreader box to a loose lift thickness of approximately 9½ inches. Initial compaction was performed by a vibratory compactor followed closely by a pneumatic tired roller (See Photo 2). Shaping was then performed by a road grader with final compaction by a smooth steel wheel roller (See Photo 3). Subsequent coring of the soil cement course indicated a final compacted thickness averaging 6½± inches. Due to maintenance of traffic considerations, the soil cement course was placed one lane at a time. For at least 48 hours after final compaction, the top surface was kept moist by the application of water by a pressurized spray bar to insure proper curing (See Photo 4). After that time, a bituminous seal coat was applied and after drying, traffic was allowed to run on the course where necessary (See Photo 5).

In the experimental section, the reinforcing bars were set in place just prior to final rolling by the smooth steel wheel roller. In the rolling operation, the bars were "punched" into the top of the soil cement course and then removed and moved ahead, resulting in the desired "built-in" shrinkage joint (See Photos 6 & 7). No construction problems were encountered in obtaining the groove.

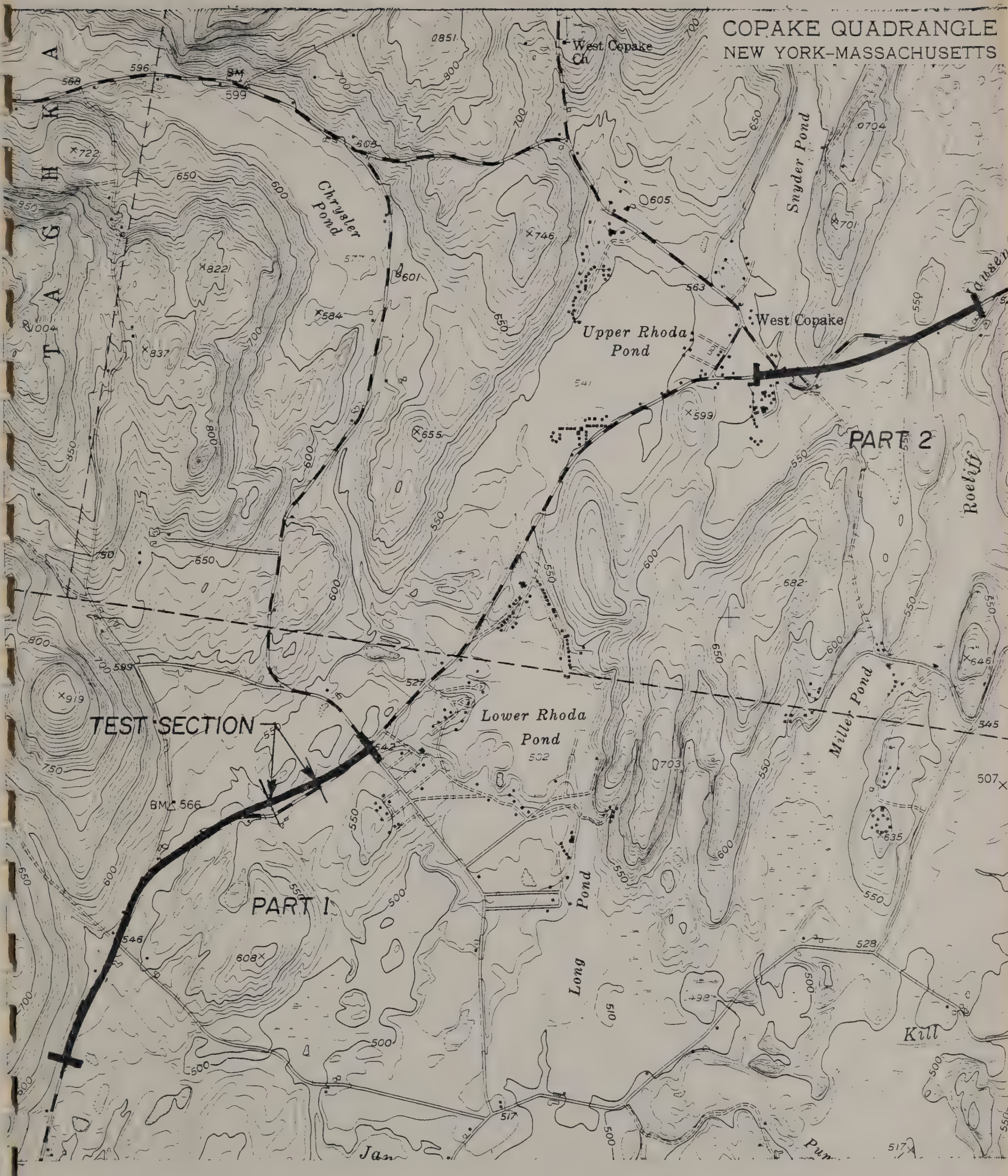
V PERFORMANCE EVALUATION

A short while after placement of the 1½ inch asphalt surface course, the shrinkage cracks in the soil cement course reflected through to the surface throughout the project. Within the test section, these cracks appeared as a relatively straight line on 20± foot centers (See Photos 8 & 9). In all areas outside the test section, however, the normal erratic cracking occurred on from 18 to 41 foot centers (See Photos 10 & 11). Further periodic inspections have indicated no change.

VI CONCLUSIONS

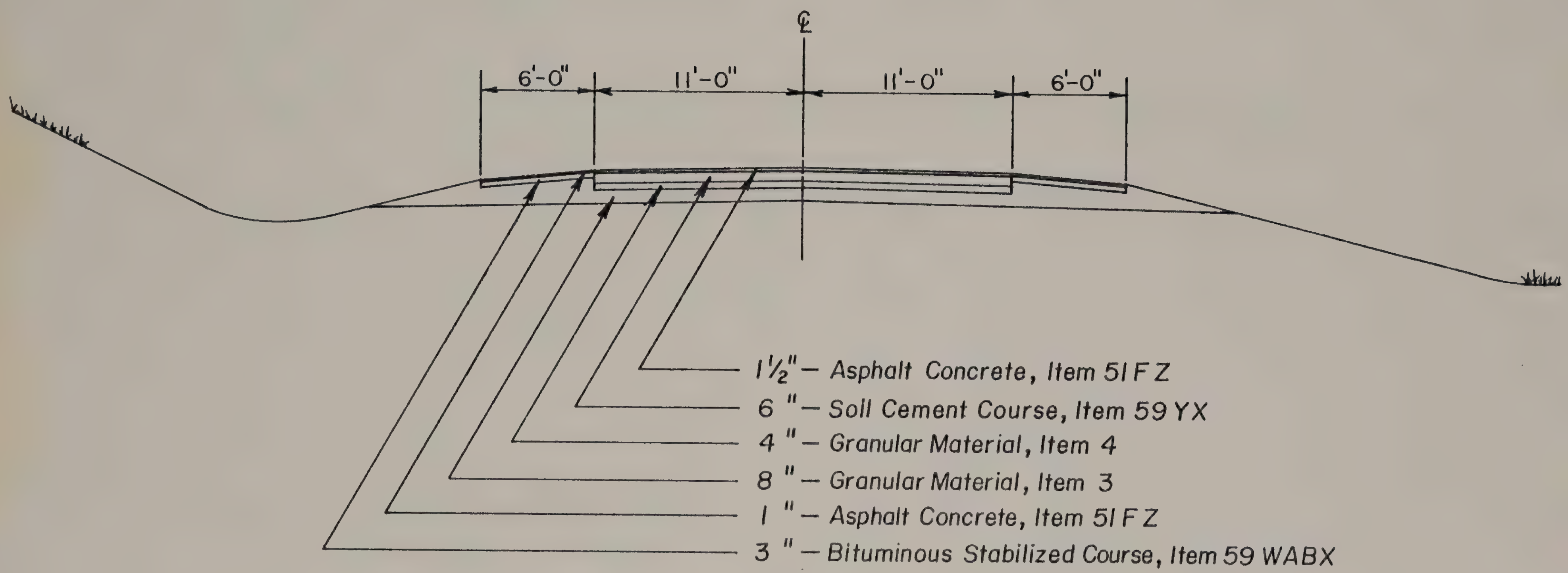
By all observation to date, the test method employed on this project to control the inevitable shrinkage cracks has accomplished the desired result; i.e. a relatively straight crack at a predetermined interval.

FIGURES



LOCATION MAP

FIGURE 1



NORMAL SECTION

EARTH

NO SCALE

FIGURE 2

PHOTOGRAPHS

PHOTO 1
SOIL CEMENT MIXING OPERATION

PHOTO 2
SPREADING AND INITIAL COMPACTION

PHOTO 3
FINE GRADING AND FINAL COMPACTION

PHOTO 4
APPLYING WATER TO INSURE PROPER CURING

PHOTO 5
SOIL CEMENT COURSE AFTER APPLICATION
OF BITUMINOUS SEAL COAT

PHOTO 6

PHOTO 7
"BUILT-IN" SHRINKAGE JOINTS IN TEST SECTION

PHOTO 8

PHOTO 9
RESULTANT SHRINKAGE CRACKS THROUGH
ASPHALT WEARING COURSE IN TEST SECTION
NOTE-RELATIVE STRAIGHTNESS

PHOTO 10

PHOTO 11
NORMAL SHRINKAGE CRACKING OUTSIDE
OF TEST SECTION
NOTE-ERRATIC PATERN

APPENDIX

ITEM 59YX - SOIL CEMENT COURSE

All requirements for 59Y shall apply, except for the following modifications:

The soil of this course shall meet the requirements of Item 3, except that the particles shall not exceed such size as will pass through a 1½ inch square hole, and not more than 50% by weight shall pass the No. 40 mesh sieve, and not more than 20% by weight shall pass the No. 200 mesh sieve.

The materials shall be mixed at a central twin shaft pugmill mixing plant. Mixing materials in a traveling pugmill or traveling power driven rotary mixing machine will not be allowed.

Where Item 59YX is used as a course supporting other pavement courses, the finished surface of the course shall not extend above, nor be greater than one-half (½) inch below true grade and surface at any location.

Cement will be paid for under Item 15-2A, Portland Cement Type 2A.

CONTROLLED CRACKING OF SOIL CEMENT COURSE

To determine the possibility of controlling the inevitable lateral shrinkage cracking of a soil cement course, the following procedure will be performed between Sta. 135+00 C/L and Sta. 143+00 C/L Part 1 of the subject project.

Immediately following the placement of the full 22 foot wide soil cement course and prior to rolling operations, ten (10) No. 5 Reinforcing Bars, 24 feet in length, will be placed laterally on the soil cement course, 20± feet on centers and rolled into the surface. Upon completion of rolling operations, said bars will be lifted and moved forward repeatedly to the limits of the stations indicated.

The bid price for this trial operation will be included in the price bid for soil cement item, except that reinforcing bars will be paid for under Item 28.

SUMMARY OF LABORATORY TEST RESULTS
SOIL CEMENT CORING PROGRAM

PROJECT ANCRAM-COPAKE COUNTY COLUMBIA REGION 8 CONT. NO. FASS

CORE NO.	DATE PLACED	STATION	DATE CORED	LENGTH OF CORE	SPEC. GRAVITY	WET DENSITY	TEST	% LOSS F-T	COMPRESSION TEST TOTAL LOAD	COMPRESSION TEST P.S.I.
1	7-23	79+55	8-6	5.5"						
2		79+70		5.0"	No testing done on this series of					
3		79+78		5.25"	cores - Partial recoveries only.					
4		80+25								
5		80+30								
14	7-24	81+30	8-6	6.5"	2.34	146.0	15 day		9,825	759
15		88+10		6.25"	2.31	144.1	28 day		12,750	980
16		95+00		7.0"	2.40	149.8	92 day		18,650	1,455
17		83+95	8-29	6.25"	2.29	142.9	F-T	.9		
21	7-25	97+60	8-6	6.5"	2.37	147.9	14 day		14,475	1,188
22		104+90		6.5"	2.35	146.6	28 day		12.600	973
23		111+15		5.75"	Sample Broken - No Testing					
24		111+35		6.0"	2.31	144.1	91 day		No Test	
25		95+00		6.5"	2.32	144.8		E.I.C. Fran Edgley		
26		89+40		6.5"	2.29	142.9	F-T	35-40*		
27		105+50	8-29	6.5"	2.35	146.6	Obs.			
28		101+45		6.0"	2.32	146.8	Obs.			
31	7-28	92+40	8-6	6.0"	2.54	158.5	14 day		11,400	871
32		103+05		6.5"	2.36	147.3	28 day		12,475	963
33		112+60			2.39	149.1	Obs.			
34		112+70		7.0"	2.38	148.5	92 day		14,100	1,100
35		105+70	8-29	7.0"	2.39	149.1				

*After 10th cycle of F-T testing, testing was stopped due to excessive losses being observed after each cycle - Loss was estimated.

Note: The above dates are in 1975

SUMMARY OF LABORATORY TEST RESULTS
SOIL CEMENT CORING PROGRAM

PROJECT ANCRAM-COPAKE, COUNTY COLUMBIA REGION 8 CONT. NO. FASS 7

CORE NO.	DATE PLACED	STATION	DATE CORED	LENGTH OF CORE	SPEC. GRAVITY	WET DENSITY	TEST	% LOSS F-T	COMPRESSION TEST TOTAL LOAD	COMPRESSION TEST P.S.I.
41	7-29	122+75	8-6	7.375"	2.37	147.9	14 day		11,875	936
42		128+60		6.0"	2.31	144.1	28 "		10,100	772
43		136+02		5.0"	2.34	146.0	91 "		13,900	1,040
44		136+02		6.0"	2.36	147.3	F-T	.4		
45		137+00	8-29	6.25"	2.36	147.3	Obs.			
46		136+80		6.5"	2.37	147.9	Obs.			
51	7-30	139+05	8-6	6.875"	2.38	148.5	9 day		12,000	936
52		144+95		6.5	2.30	143.5	14 "		12,750	985
53		152+10		5.75"	2.34	146.0	28 "		14,325	1,089
54		151+25	8-29	6.75"	2.36	147.3	F-T	.4		
60	8-14	104+90	8-29	5.5"	No Test		21 day		12,425	940
61		109+55			2.40	149.8	Obs.			
62		109+57		6.25"	2.36	147.3	28 day		9,200	707
63		114+75		5.0"	2.37	147.9	F-T	.6		
64		88+25		5.25"	2.36	147.3	F-T	1.2		
65		81+00		5.75"	2.30	143.5	90 day		9,650	734
70	8-18	141+90	8-29	5.75"	No Test		17 "		10,925	831
71		128+75		6.0"	2.39	149.1	28 "		17,375	1,328
72		120+51		7.0"	2.35	146.6	91 "		16,700	1,303
73		101+20		5.25"	2.36	147.3	F-T	.7		
74		92+80		6.5"	2.35	146.6	Obs.			
80	8-19	150+75	8-29	6.75"	2.40	149.8	28 day		12,800	994

Note: The above dates are in 1975.